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BOOK REVIEW

CERN Accelerator School
Fifth General Accelerator Physics Course held at University of Jyväskylä, Finland, 7-18 September 1992
edited by S Turner
CERN-94-01 (Geneva 1994).
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The two long volumes present the fifth general accelerator physics course of the CERN Accelerator School. The CERN Accelerator School was established in 1983 with the aim to preserve and disseminate the knowledge accumulated at CERN and elsewhere on particle accelerators and storage rings of all kinds. This is given effect to, by means of biennial programme of basic and advanced two week course on general accelerator physics aiming to bridge gap between knowledge attained with science or engineering degree and that required for starting accelerator research work. Topical and specialised courses are organised as the need or opportunity arises and in conjunction with appropriate bodies or organisations in the world. The list of schools conducted and proceedings brought out (presented in this volume) is quite impressive. The successive schools have updated the information and each proceedings is comprehensive and complete in itself. Thus they have become veritably the source book of knowledge on accelerator physics.

The fifth school on general accelerator physics held at the University of Jyväskylä, Finland in September 1992, followed closely the earlier ones at Gif-sur-Yvetle (1984), Aarhus (1986), Salamanca (1988), and Julich (1990). The proceedings of these schools have been brought out as CERN Reports 85-19, 87-10, 89-05 and 91-04 respectively. According to the editor of the proceedings, the opportunity was taken not only to include lectures presented but also to seek and revise the most appropriate chapters from the previous similar schools. In this way, the present volumes, constitute a rather complete introduction to all aspects of design and construction of particle accelerators, including optics, emittance, luminosity, longitudinal and transverse beam dynamics, insertions, chromaticity, transfer lines, resonances, accelerating structures, tune shifts, coasting beams, lifetime, synchrotron radiation, radiation damping, beam-beam effects, diagnostics, cooling ion and positron sources, RF and vacuum systems, injection and extraction, conventional, permanent and superconducting magnets, cyclotrons, RF linear accelerators, microtrons, as well as application of particle accelerators (including therapy) and the history of accelerators.

The usual daily schedule of the course during the working days, was to have four one-hour lectures and a seminar after the afternoon tea break. Following eight seminar lectures—conventional magnet design, conventional RF system design, vacuum system design, ion sources, photon beam lines and monochronators, nuclear chemistry and incineration, accelerators for therapy, permanent magnets for accelerators—have also been recorded in the proceedings.

All the topics dealt in earlier workshops have been updated with the new information and experimental results available. However, the applications of particle accelerators has not only been updated but two special lectures on Accelerators for Therapy and Nuclear Waste Transition using high energy proton linear accelerators have been included. Both make very interesting reading. Information presented at the International Conference on Applications of Accelerators in Research and Industry organised every second year at Denton, Texas (Proceedings edited by J L Morgan and J L Duggan for the 10th and 11th conference. 1988, 1990 respectively) have been included. Also information from European Conference on Accelerators in Applied Research and Technology organised at Frankfurt-on-Main in 1984 and the other in 1991; European Particle Accelerator Conference held at Rome (1988) and at Nice (1990) have been included. Especially in the conference held at Nice, there were a number of papers on a variety of applications (synchrotron radiation for microlithography, radiography, nuclear waste incineration, heavy ion fusion).

The presentation of Accelerators for therapy is rather comprehensive one. It is over a decade that circular and linear accelerators have been developed for clinical use in radiation therapy for tumours with the aim of achieving high radiation dose in the tumour and as low a dose as possible in the adjacent normal tissues. Today we have over one thousand accelerators in the world and many hundred thousand patients are treated everyday with accelerator produced radiation. New types of radiations such as neutrons, negative pions, protons and heavy ions are tested recently. The clinical experience with these radiations, and with new type of treatment procedures indicate that in future, the use of scanning beam of high energy protons might be optimal for the treatment of tumours.

Nuclear waste transmutation using high intensity proton linear accelerator has also been considered in the workshop in fair details. As the high radioactive nuclear waste is collecting the world over with the proliferation of harnessing nuclear energy, geological and sea-bed disposal of long lived and highly concentrated waste is under active study in many countries. It is considered that geological storage will be as unescapable issue but the task may be alliviated by nuclear transmutation, *i.e.* the transformation in an intense neutron flux of long lived radioactive species to isotopes with shorter half lives.

A few important higher actinides and fission products with long and medium half lives in the nuclear waste are as follows : U-235 (7.1×10^8 years), Pu-239 (2.4×10^4 yrs), Np-237 (2.1×10^6 yrs), Am-243 (7.7×10^3 yrs) and Cm-245 (9.3×10^3 yrs) and fission products Tc-99 (2.1×10^5 yrs), I-129 (1.6×10^7 yrs) and shorter lived but quite abundant Sr-90 (28 yrs) and Cs-137 (30 yrs). Many proposals have been made on the use of high fluxes of fast or thermal neutrons. Fast neutrons were favoured because of the high ratio of fission to capture cross sections. The reduction of waste hazards by transmutation will have to be preceded by chemical separation of wastes.

Recently (1989), a new proposal has been advanced at Los Alamos. It is based on the production of extremely high flux of thermal neutrons ($>10^{16}$n/cm^2–sec, 100 × standard reactor fluxes) by a high power proton linear accelerator. Neutrons are produced by a high current proton beam of 1 to 1.6 GeV energy impinging on a flowing liquid Pb-Bitarget generating about 55 spallation neutron per proton. The primary target is surrounded by a blanket of D_2O, moderating neutrons to thermal energies. Waste material is carried continuously in pipes through the moderator and transmuted in the high thermal neutron flux. Several high intensity proton linacs are being considered for converting to dedicated waste transmutation facility. The paper in the workshop considered various aspects of safety precautions in this project.

Overall, the proceedings of the workshop is a practical companion to any active accelerator physicist and will form a good reference source to an initiator in the field.

B B Baliga
9A, Sevak Baidya Street,
Calcutta-700 029